CULATED LOWER BODY EXERCISER

RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 07/984,301 filed Dec. 1, 1992, now U.S. Pat. No. 5,299,993.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the field of exercise equipment, and particularly to a lower body exerciser that combines elements of both a stepping exercise and a running exercise.

2. Prior Art

A wide variety of exercise devices have been developed for exercising the various muscle groups of the human body. One class of such devices that is particularly adapted for exercising the lower body consists of cycle-type exercisers. These machines generally simulate the exercise experienced when pedaling a cycle. The operator sits in either an upright, semi-recumbent or recumbent position and operates a pair of foot pedals on a crank shaft. The operator's feet travel in a circular path, each foot constrained to move exactly out of phase with the other.

Another class of machines for exercising the lower body consists of treadmills that permit a walking or running exercise. In a treadmill exercise, there is typically no resistance other than the weight of the operator's body, the effect of which may be amplified by elevating the forward end of the treadmill.

Yet another class of lower body exercisers that has become popular in recent years, consists of machines that simulate climbing stairs. These machines typically have a pair of pedals pivotally mounted to a frame for up and down movement in a accurate path. Operation of the pedals may be either dependent or independent. Typically, resistance is provided only for the downward stroke of each pedal so that the resulting exercise accurately simulates stair climbing.

Each of the above-mentioned classes of lower body exercisers is useful for achieving particular exercise objectives; however, each such class of exerciser is also limited by the inherent mechanical limitations on the range of motion.

SUMMARY OF THE INVENTION

One of the objects of the present invention is to provide an exercise machine that combines the benefits of the specific exercises that can be performed individually on prior art lower body exercisers.

Another object of the present invention is to provide a lower body exerciser with a range of motion heretofore unachievable with prior art exercisers.

These and other objects of the present invention are achieved in a machine having a pair of laterally spaced apart foot pedals, each of which is independently coupled to a frame by a respective articulated linkage. Each such articulated linkage has a generally vertical linkage that is pivotally coupled to the frame and a generally horizontal linkage that is pivotally coupled to its respective foot pedal. These linkages, each of which may comprise a single or a pair of linkage arms, are pivotally coupled to one another such that each foot pedal is free to move within a two-dimensional envelope of motion in a vertical plane. The linkage arms are arranged so that the envelope of motion has a generally

ovate shape, slightly inclined to the horizontal. The exercise performed with this apparatus involves both vertical motion as with prior art machines that simulate stair climbing and horizontal motion as with prior art treadmills. The vertical and horizontal components of motion may each have separate resistance means. Furthermore, the rearward horizontal component of motion may be externally powered or powered solely by the operator, just as with a treadmill.

In one embodiment of the invention, the vertical linkages are interconnected by a crank assembly so that the horizontal motion of the two articulated linkages is an alternating reciprocating striding motion. This facilitates use of the machine in a runner/walker mode of operation which may be selectively combined with a vertical component of exercise motion. The crank assembly may be locked in position to operate the machine purely as a stair-climbing simulator without a horizontal component of motion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a overall perspective view of an apparatus according to the present invention.

FIG. **2** diagramatically illustrates the range of motion of the apparatus shown in FIG. 1.

FIG. **3** diagramatically illustrates a modification of the present invention as shown in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, for purposes of explanation and not limitation, specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed descriptions of well-known methods and devices are omitted so as to not obscure the description of the present invention with unnecessary detail.

An apparatus **10** according to the present invention is shown generally in FIG. 1. A frame **12** comprises a generally upright member **14** and a base member **16**. Frame **12** is supported on a floor by front leg members **18** and rear leg members **20**. Frame **12** is conveniently fabricated from square or rectangular section steel tubing as is conventional in the field of exercise equipment.

A pair of brackets **22** are welded or otherwise secured to upright member **14** at an intermediate position thereon. A pair of articulated assemblies **24** are suspended from brackets **22**. Assemblies **24** are disposed on opposite sides of a longitudinal center line of frame **12**. Each of articulated assemblies **24** is coupled to a respective foot pedal **26**.

Each of identical articulated assemblies **24** comprises a vertical linkage arm **28**, a lower horizontal linkage arm **32** and an upper horizontal linkage arm **34**. Vertical linkage arm **28** is pivotally coupled to bracket **22** at pivot point **28***a*. The horizontal linkage arms **32** and **34** are pivotally coupled to vertical linkage arm **28** at pivot points **36***a* and **36***b*, respectively. Horizontal linkage arms **32** and **34** are also pivotally coupled to foot pedal bracket **27** at pivot points **32***a* and **34***a*, respectively. Lower horizontal arm **32** is preferably longer than upper horizontal arm **34** in order to progressively tilt the foot pedal through its range of motion as described below. In an alternative embodiment, a pair of vertical linkage arms may be employed so that articulated assembly **24** comprise two complete four-bar linkages. In this variation of the

invention, an intermediate linkage connector is used to couple the pairs of vertical and horizontal linkage arms.

As will be more fully explained below, articulated assemblies **24** allow their respective associated foot pedals **26** to move within a two-dimensional envelope of motion in a vertical plane parallel to the longitudinal center line of frame **12**. To utilize device **10**, an operator stands facing upright member **14** with each foot on a respective one of foot pedals **26**. Handrails **38**, to be grasped by the operator for balance and support, extend from rear leg members **20** upwardly and forwardly to upright frame member **14**. A display and control panel **40** houses a microprocessor-based control system for the apparatus and includes display devices for providing the operator with pertinent information regarding the exercise being performed. Panel **40** also includes input devices for selecting various exercise parameters.

Foot pedals **26** are preferably biased towards an upward and forward position which provides a convenient starting position for the exercises that may be performed utilizing apparatus **10**. A spring **42** is attached to a tab **44** which in turn is secured to base member **16**. A short cable **46** is attached to the opposite end of spring **42** and is reeved around pulley **48** which is rotatably mounted to upright member **14**. Cable **46** is attached to vertical linkage member **28** near linkage connector **36**. The length of cable **46** is such that spring **42** is maintained in tension even when vertical linkage member **28** is resting against stop **50**. The characteristics of spring **42** are selected so as to provide the desired amount of forward biasing force for articulated assembly **24**.

In similar manner, spring **52** provides a vertical biasing force. One end of spring **52** is attached to tab **54** which in turn is secured to upright member **14**. The opposite end of spring **52** is coupled to cable **56** which is reeved over pulley **58** rotatably mounted on bracket **22** concentric with pivot point **28***a*, and then over pulley **60** which is rotatably mounted on vertical linkage member **30**. Cable **56** is attached to horizontal linkage member **34**. The length of cable **56** and the characteristics of spring **52** are selected so as to provide the desired amount of upward biasing force for articulated assembly **24**.

It will be recognized that apparatus **10** may be used to perform exercises against the resistance afforded only by springs **42** and **52**. However, it is preferred that these springs be used only to bias the foot pedals **26** into their upward and forward resting positions and that separate means **100** be provided for regulating and/or resisting movement of the articulated assemblies. Numerous resistance means suitable for use with apparatus **10** are well known in the art. In particular, various forms of electromechanical resistance have been successfully developed for use with exercise machines that simulate stair climbing. For example, U.S. Pat. No. 4,708,338 to Potts discloses a resistance system utilizing an electrical alternator and a variable load resistor to provide dynamic braking. Such a system is easily adapted for use with the present invention. Another resistance system utilizing a flywheel and friction belt is disclosed in U.S. Pat. No. 4,938,474 to Sweeney et al. This system is also easily adapted to the present invention.

The foregoing examples are not the only means for providing resistance that are suitable for use with the present invention. Indeed, virtually any device for providing resistance may be adapted for use with this invention, such as weights, springs, electromagnetic devices, etc. Furthermore, it will be recognized that the present invention may also be advantageously employed in modes that regulate or control the operator's motions rather than simply providing resistance.

Articulated assemblies 24 are coupled to the resistance means by drive shaft 70. Separate drive pulleys are provided for the vertical and horizontal linkage members. Drive pulley 72 is coupled to vertical linkage arm 28 by flexible member 74. In like manner, horizontal linkage arm 34 is coupled to drive pulley 76 by flexible member 78. Corresponding drive pulleys and flexible coupling members, although not shown, are provided for the articulated assembly on the left side of apparatus 10. Flexible members 74 and 78 may be cables, chains, belts or other transmission devices as are conventionally used in the art of exercise equipment. As illustrated in FIG. 1, apparatus 10 has a single drive shaft 70. However, it can readily be seen that separate drive shafts and separate resistance means may be provided for the respective vertical and horizontal linkage arms. In this manner, the resistance for the vertical and horizontal components of motion may be separately selected. By extension, resistance means could also be separately provided for each of the pair of articulated assemblies, although the expense and complexity of doing so would likely outweigh any benefits.

Referring now to FIG. 2, the path followed by one of the foot pedals 26 in the course of performing an exercise with apparatus 10 is illustrated. Position A is the rest position in which foot pedal 26 is biased to an upward and forward position by the action of springs 42 and 52 as explained above. In this position, foot pedal 26 is substantially horizontal, thereby permitting an operator to simply step up onto the foot pedals in order to perform an exercise. As the operator's weight is transferred to foot pedal 26, it begins to descend, pivoting primarily about pivot points 36*a* and 36*b* until horizontal linkage arm 32 is in contact with roller 80 as illustrated at position B. In this position, foot pedal 26 is slightly inclined. This gives the operator greater leverage for performing the optional horizontal stroke of the exercise.

From position B, the operator may simply transfer weight to the opposite foot pedal, thereby returning to position A and thus performing a simple vertical step exercise. Alternatively, from position B, the operator may push backward against foot pedal 26 to add a horizontal running stroke to the exercise. This stroke, the length of which is determined by the natural stride of the operator, terminates at position C. At this position, the inclination of foot pedal 26 has increased. From position C, the operator will naturally transfer weight to the opposite foot pedal, and the foot pedal shown in FIG. 2 will tend to return to starting position A under the influence of springs 42 and 52. The foot pedal is not constrained to follow a particular path from point C back to point A; instead, the pedal follows the natural path of the operator's foot, which is generally a smooth, curved path as illustrated.

An optional feature of the present invention is to provide a source of power, such as a D.C. motor, for roller 80 so that the horizontal stroke between positions B and C is powered, much in the manner of a treadmill. When operating in this mode, the individual expends energy to keep pace with retreating foot pedal 26, but is not applying muscular energy to force it backward as in the unpowered mode. With the option of supplying power to roller 80, it is desirable to have an unpowered idler roller 82 immediately behind roller 80 so that the terminal portion of the horizontal stroke is unpowered. This is important for safety considerations and also provides a more pleasing feel to the exercise. It will be seen that as the horizontal stroke proceeds from position B to position C, horizontal linkage member 32 "tips over" roller 80 to engage roller 82 and thereby disengage from roller 80.

It will be appreciated that apparatus 10 can be operated in a number of different modes. The operator may utilize

vertical only or both vertical and horizontal components of motion. Furthermore, the resistance for each component of motion may be the same, or resistance to horizontal motion may be a predetermined percentage of the resistance to vertical motion, or each component may be separately adjusted or eliminated entirely. Also, as just discussed, the horizontal component of motion may be powered in a backward direction in the manner of a treadmill, which may be used in combination with any desired resistance to the vertical component of motion. Thus, a variety of exercises may be performed to focus on the particular needs and desires of the operator.

FIG. 3 illustrates a modified version of the above-described exerciser. Apparatus **110** is fundamentally similar to apparatus **10**. Components of the modified device that are functionally equivalent to components of apparatus **10** have corresponding reference numerals appended with a prime. Apparatus **110** has a pair of identical articulated assemblies **24'**; however, only one such assembly is shown for the sake of clarity. Vertical linkage arm **28'** is coupled to frame **12'** at pivot point **28***a'*. Arm **28'** is coupled to crank assembly **120** by arm **122***a*. Crank assembly **120** includes crankshaft **124** and crank arm **126***a*, to which arm **122***a* is attached at crank pin **128***a*. Crank arm **126***b* is also attached to crankshaft **124**, 180° out of phase from crank arm **126***a*. Arm **122***b*, which is only partially shown, is coupled to crank arm **126***b* at crank pin **128***b* and is also coupled to the other vertical linkage arm (unseen in the figure).

As a result of the interconnection of vertical linkage arms **24'** by crank assembly **120**, pivotal motion of either of the arms about pivot point **28***a'* causes a corresponding but opposite pivotal movement of the other arm. The two vertical linkage arms thus move with an alternating reciprocating action when the user introduces a horizontal component of motion in the exercise, i.e., when apparatus **110** is used in other than a purely stair-climbing simulation mode. If the crank assembly is locked in position, the vertical linkage arms remain stationary (preferably with both arms parallel) and the only exercise movement possible is vertical movement of the horizontal linkage arms **32'**, **34'**, thereby providing a simulation of stair climbing.

Crank assembly **120** is preferably coupled to a flywheel **130** which, in turn, is coupled to a motor **132** and an exercise resistance unit **134**. The latter may comprise a friction belt **136** and a belt engagement device **138** for varying the tension in belt **136**. Such a resistance unit is described, for example, in U.S. Pat. No. 4,938,474. Resistance against vertical movement of the horizontal linkage arms is provided in the same manner as described above for apparatus **10**.

When apparatus **110** is operated in a runnerwalker mode, crank assembly **120** is preferably initially powered by motor **132** to establish the exercise motion. After a predetermined